*Non-Binding Arbitration initiated 10/21/08*
*pursuant to*
*Decree of May 19, 2003, 538 U.S. 720*
*Kansas v. Nebraska & Colorado*
No. 126, Orig., U.S. Supreme Court

# Kansas's Expert Response to Nebraska's Expert Report, "Estimating Computed Beneficial Use for Groundwater and Imported Water Supply under the Republican River Compact"

Prepared by

David W. Barfield, P.E.
Chief Engineer, Division of Water Resources
Kansas Department of Agriculture,

Steven P. Larson
S. S. Papadopulos & Associates, Inc

and Dale E. Book, P.E.
Spronk Water Engineers, Inc

February 17, 2009

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## I. Executive Summary

The FSS requires that the RRCA Groundwater Model be used to determine the values for GW CBCU and Imported Water Supply (IWS) credit for inclusion in the Accounting Procedures. Procedures in the FSS identify the specific model runs to be used to make these calculations. The specifications described in the FSS were established by the Modeling Committee, which was responsible for developing the Model and the methods for its application. Nebraska is recommending that the Accounting Procedures be changed to add new model runs not currently specified by the FSS.

The reason stated for Nebraska's proposed change is that the impacts computed pursuant to the specifications in the FSS do not sum to the impacts derived using a new model run. However, the new model run is not necessary to implement the Republican River Compact. The individual impacts are necessary elements of the Compact accounting, and the Modeling Committee reasonably developed the specifications to compute those impacts using the historical baseline to which the Model was calibrated. As documented in the FSS and subsequent reports of the Special Master, the Model and Accounting Procedures provide reasonable and appropriate results.

Nebraska's proposal especially affects the amount of the IWS credit calculated for Nebraska. For the years 2001 to 2006 , the credit would be increased by 60% above values computed using the approved method and would be larger than the values computed for years prior to 2000 by either the approved or proposed methods. Accretions from Platte River recharge create the IWS credits and must be determined with the Model. The accretions are highly dependent on the amount of water diverted from the Platte and water level conditions in the mound area of the basin. Both of these conditions must be properly accounted for with the Model to provide reasonable results. The approved methods compute the IWS credit from comparison with a historical baseline condition that considers actual water level conditions, with Nebraska pumping occurring. Nebraska's proposal creates an artificial baseline condition with Nebraska pumping not occurring, which has the effect of increasing the amount of IWS credit. , which causes the increases described above.

The currently approved methods produce reasonable and appropriate results required for the Compact accounting by using the historical baseline conditions. Nebraska's assertion that there is an assumption of additivity implied in the current accounting procedures is not borne out by the documentation of the Model and Accounting Procedures. The method proposed by Nebraska includes a baseline for computing IWS that has water levels generally above actual levels and increases the computed IWS. For these reasons, the Nebraska proposal should not be adopted.

## II. Introduction

This report responds to Nebraska's expert report entitled "Estimating Computed Beneficial Consumptive Use for Groundwater and Imported Water Supply under the Republican River Compact," by Ahlfeld, McDonald and Schneider, January 20, 2009 ("Ahlfeld Report").

The Ahlfeld Report proposes a change to the Republican River Compact Administration ("RRCA") Accounting Procedures. Specifically, it recommends a change in the methods by which the Computed Beneficial Consumptive Use ("CBCU") and the Imported Water Supply Credit ("IWS") are computed using the RRCA Groundwater Model ("Model"). The Ahlfeld Report proposes that CBCU and IWS be computed by using additional model runs not currently part of the accounting procedures and a weighted average of differences between numerous base conditions and impact runs. The premise for this change is that the current methodology is based on an incorrect assumption made by the States and Special Master. ("The current Accounting Procedures assume that this additivity will apply to all model results." Ahlfeld Report, p. 43). However, this assumption was not made and is not necessary for the Accounting Procedures.

The selection of the model runs to use to compute depletions due to groundwater pumping and accretions due to Platte River recharge in the approved methods was made with full consideration of how the Model was constructed, what its tendencies were and what results it produced. This report explains why the Nebraska assertion of error in the Accounting Procedures is incorrect and the methods used are reasonable.

The RRCA Accounting Procedures and Reporting Requirements prescribe the methods for using the Model to compute the Beneficial Consumptive Use of Groundwater (GW CBCU) and the Imported Water Supply (IWS) Credit. Those methods have two principal requirements. First, a base Run of historical conditions is made. Second, a set of alternative runs is required, with the specific input data to be removed from the model datasets for each alternative run identified. For example, the specific method for computing the IWS Credit from Section III.A of the Procedures is as follows:

> *The amount of Imported Water Supply Credit shall be determined by the RRCA Groundwater Model. The Imported Water Supply Credit of a State shall not be included in the Virgin Water Supply and shall be counted as a credit/offset against the Computed Beneficial Consumptive Use of water allocated to that State. Currently, the Imported Water Supply Credits shall be determined using two runs of the RRCA Groundwater Model:*
>
> *a. The "base" run shall be the run with all groundwater pumping, groundwater pumping recharge, and surface water recharge within the model study boundary for the current accounting year turned "on." This will be the same "base" run used to determine groundwater Computed Beneficial Consumptive Uses.*
>
> *b. The "no NE import" run shall be the run with the same model inputs as the base run with the exception that surface water recharge associated with Nebraska's Imported Water Supply shall be turned "off."*
>
> *The Imported Water Supply Credit shall be the difference in stream flows between these two model runs. Differences in stream flows shall be determined at the same locations as identified in Subsection III.D.1.for the "no pumping" runs. Should another State import water into the Basin in the future, the RRCA will develop a similar procedure to*

*determine Imported Water Supply Credits* (Kansas v. Nebraska & Colorado, No. 126 Orig., FINAL SETTLEMENT STIPULATION, VOL. 1 OF 5, (FSS), December 15, 2002, p. C17).

A similar procedure is used to compute each State's GW CBCU.

**III. RRCA Groundwater Model and Accounting Procedures**

When the States and the United States agreed to the Final Settlement Stipulation (FSS), on December 15, 2002, they had completed and agreed to much of the Model; since such agreement was necessary to consent to the FSS. The RRCA Groundwater model was adopted on July 1, 2003. The status and agreements were documented in the FSS and Appendices, published December 15, 2002. Appendix J to the FSS (Volume 5) described the status of the model at that time, including agreements reached as of that time. Appendix C to the FSS consists of the Accounting Procedures, which describe the specific steps to be followed with the Groundwater Model to obtain the IWS Credit and GW CBCU (as referenced above). The FSS also provided procedures for resolving disagreements which might arise between November 15, 2002 and the final adoption of the Model by the RRCA. Because all three states agreed to the Model, it was not necessary to invoke these procedures.

The Modeling Committee, which developed the Model and the procedures for using it, was comprised of members designated by each State and the United States. Each State had three members and the Untied States two. The members of the Modeling Committee participated in all aspects of the Model development, including the structure, sources of data, calibration and use of the Model. The development of the Model and Accounting Procedures through the collaborative efforts of the Committee was described as providing a better tool than would have been possible through litigation, due to the constructive process and joint efforts (Second Report, pp. 48-49). They considered and used a wide range of parameters, analytical processes and calibration techniques. Many aspects of the modeling process, such as base flow separation, precipitation recharge (including changes due to irrigation), phreatophyte coverage and ET function, and irrigation efficiency to determine net pumping were determined to have direct and significant effects on the computed impacts being derived for use in the Compact Accounting

The calibration of the Model to historical base flow and water levels was a very important aspect of the Model development. The agreed upon baseflow targets were included in the Model progress report in the FSS. The Committee had computed the impacts of groundwater pumping over an extended historical period, from the pre-development conditions of 1918 through the post-development conditions of 2000. As the Special Master noted in the Second Report, the States agreed to "the architecture, parameters, procedures and calibration targets" at the time of the FSS and that "the Model matches as closely as possible the actual effects of both alluvial and table-land pumping on stream flow in the Basin." (Kansas v. Nebraska & Colorado, No. 126 Orig., SECOND REPORT OF THE SPECIAL MASTER (SUBJECT: FINAL SETTLEMENT STIPULATION) (Second Report), April 15, 2003, p. 38). The Special Master further noted the importance of the calibration to historical conditions to the States:

> *In the words of David Pope, Chief Engineer and Director of the Kansas Department of Agriculture, Division of Water Resources, the goal of the Modeling Committee's calibration of the Groundwater Model is to ensure that it "is replicating the actual known historical stream flow as compared to what the model predicts."*

*Id.*, n. 63, pp. 37-38. All three states agreed that the Model must be calibrated to correspond with actual historical conditions. The requirement for correspondence with observed conditions is generally accepted procedure in the application of models.

When the Modeling Committee had completed its work, its members agreed that the Model was sufficient for its intended purposes, including the specific method for using the Model's results in the Accounting Procedures. Because the Model was not finalized at the time the FSS was completed, the FSS contained a provision that allowed for binding arbitration if disagreement arose among the states concerning the Model. However, none of the states, including Nebraska, invoked this provision to take an issue to binding arbitration. Instead, the states agreed that the Model and the methods proposed were sufficient for its purpose. It is well documented that each of the States and their respective members on the Modeling Committee were aware of the purpose of the Model, its assumptions and limitations (Kansas v. Nebraska & Colorado, No. 126 Orig., FINAL REPORT OF THE SPECIAL MASTER WITH CERTIFICATE OF ADOPTION OF RRCA GROUNDWATER MODEL (Final Report), September 17, 2003, p. 9).

At the first annual Compact meeting following the completion of the FSS in 2003, the RRCA adopted the FSS Accounting Procedures and the Model as rules and regulations of the RRCA. Since then the RRCA has completed a careful review of the Accounting Procedures, amending them to correct minor problems and omissions, and to allow for improved data. The RRCA has also revised the Model to correct minor problems and to make the Model operate more efficiently.

Nebraska's experts now state that "current accounting procedures assume that this additivity will apply to all Model results (Ahlfeld Report, p. 43)." However, there are no statements or other indications in the documentation of the Model that the Committee assumed additivity would always apply, or considered it a necessary condition for use of the Model results. But the states agreed that, taken as a whole, the Model does what is necessary for the Compact accounting.

Nebraska notes that the Special Master's statement about the role of the Groundwater Model in the Accounting Procedures is misleading (Ahlfeld Report, p. 5) because the Model does not calculate depletions. However, the Special Master's statement accurately describes the direct use of the Model to derive the amounts necessary for the Accounting Procedures. Nebraska's statement should not be accepted as a valid criticism of either the description of the Model or the methods used in the Accounting Procedures. The Accounting Procedures state that the difference in Model results from two runs "is assumed to be the depletions to streamflow", for use in the accounting. This is a common use of models. The Modeling Committee made explicit that the Model was to be used to directly compute depletions and accretions as the

differences of Model results from the historical baseline condition. To introduce other baselines would not have been acceptable, given the emphasis placed on the calibration results.

**IV. Nebraska's Recent Efforts to Change the Accounting Procedures**

In June, 2007, Nebraska gave notice to the other States that it wanted to change the Accounting Procedures, using a different baseline model run and then comparing the "no NE import run" to this new baseline, to determine the GW CBCU. The proposal to remove the historical baseline condition from the computation of GW CBCU was not accepted by Kansas and Colorado for a number of reasons. The condition proposed for computing pumping impacts on streamflows did not consider the actual water levels, by assuming that Platte River recharge was not occurring. This assumption resulted in an understatement of pumping impacts on streamflows. Ultimately, Nebraska agreed that it was inappropriate to compute the pumping impacts exclusively from this new baseline.

Nebraska subsequently withdrew this specific proposal and stated that a number of alternative scenarios could be used to calculate the effects used in the accounting, noting that different methods would yield significantly different results (January, 2008). This was followed by a Nebraska statement in March, 2008 that if two equally reasonable pairs of scenarios give different answers, then the Accounting Procedures must be changed to account for the differences. Neither the January nor March, 2008 statements asserted that there were any technical flaws in the Accounting Procedures specified in the FSS.

In August, 2008, before the RRCA Engineering Committee, Nebraska proposed a variation for computing the IWS credit and GW CBCU. This variation proposed adding a number of new model runs which would provide a range of possible results from the Model, and then averaging those results for input to the Compact Accounting. The Engineering Committee took no action on this proposal.

The methodology described in that report was modified for the proposal currently under consideration (Ahlfeld Report). The current proposal would result in substantial changes to the computed IWS credit and impacts of pumping on certain tributaries and IWS. These changes are caused by introducing new baselines for derivation of impacts that are different from actual historical conditions.

The Ahlfeld Report's proposal to re-compute GW CBCU and the IWS would significantly increase the amount of the IWS credit to Nebraska beyond the values determined using changes from the calibrated historical condition. It is important to evaluate proposed changes by comparing the new results with those considered and adopted as part of the Model documentation by the Modeling Committee (Final Report, p. 51 and Appendix U).

## V. Nebraska's Proposed Changes to the Accounting Procedures

The Ahlfeld Report proposes a new method for computing GW CBCU and IWS. That method is premised on the conclusion that the difference in results from two of the model runs should be accepted as the "true" amount of net CBCU associated with groundwater pumping and imported water. First, it must be clearly recognized that the "true" or actual value of net CBCU associated with groundwater pumping and imported water is unknown. It must also be understood that many different factors and parameters affect the location and amount of stream depletions or accretions calculated by the RRCA Groundwater Model and that uncertainty in all of these factors and parameters contributes to uncertainty in Model results.

The Ahlfeld Report describes the issue as follows:

> *The problem arises from the assumption that the correct impact of a given stress in a sub-basin can be determined from the difference of a run of the RRCA Groundwater Model in which all stresses are active and one in which the target stress is inactive* (Ahlfeld Report, p. 1).

This description does not accurately reflect what is assumed by the FSS. The FSS recognizes that the Model provides estimates of depletions or accretions. The "true" or "correct" values are unknown. For purposes of the FSS, it was agreed that specific model runs would be used to make determinations of depletions as departures from the historical baseline for use in the compact accounting. These determinations were understood to be specific calculations using the Model and were not assumed to be the "true" or "correct" values. It was also clear that the Model structure contained non-linear components which could affect the additive properties of the depletion calculations. Some non-linear components, such as aquifer transmissivity, were idealized as linear (that is, constant) for specific reasons with the knowledge that such an idealization could affect the Model results to some degree (Final Report, p. 31).

The states together accepted the approximations and idealizations of the Model as adequate to calculate depletions and accretions as input to Compact Accounting. Three examples from the Model reveal how the Modeling Committee worked out compromises on these procedures. First, the relationship between precipitation and groundwater recharge is considered to be different on irrigated land than on non-irrigated land. The actual degree of that difference was the subject of extensive discussion within the Modeling Committee, which adopted a compromise for use in the compact accounting (Final Report, p. 20).

Another uncertain model parameter that is especially important in determining the amount and distribution of depletions and accretions is evapotranspiration. Losses due to evapotranspiration are a significant component of the RRCA Groundwater Model water budget (Final Report, page 16). The impact of evapotranspiration on the amount and distribution of depletions and accretions is even more significant in that it can often produce a "salvage" effect that reduces the amount of impact that declining groundwater levels might have on streamflow depletion. The actual degree of "salvage" that occurs is uncertain but it has been included in the Model for purposes of providing a tool for compact accounting. At times the inclusion of

evapotranspiration changes produces counter-intuitive results such as stream flow accretions caused by groundwater pumping. These counter-intuitive results have nevertheless been included in the compact accounting because they represent the results from the calculation process that was agreed to in the FSS.

Results from the RRCA Groundwater Model should not be characterized as "true". Calculations of the difference in base flows between the historical base run and a "no State pumping" run are *considered* to be the depletions for purposes of compact accounting (Final Report, page 50). This characterization plainly shows that these calculated depletions may not be the *actual* depletions. Furthermore, the Model documentation report is careful to not characterize the Model as perfect, but rather uses such terms as "reasonable" and "sufficient" (Final Report, pp 10, 49 and 51) for purposes of providing a tool for compact accounting. The report is also careful to acknowledge that the Model does not assess certain practices such as land use and conservation practices or reservoir operations that could also have an impact on stream flow conditions (Final Report, p. 8). Ultimately, the RRCA Groundwater Model was developed through a collaborative process by technical experts from all three States to provide a tool for use in compact accounting (Final Report, p. 9).

There is no disagreement by any of the states that there are non-linear effects produced by the Model due to the relationship between groundwater pumping, evapotranspiration and stream effects. Groundwater pumping induces changes to storage, ET, and streamflows in complex manners both spatially and temporarily. These effects are especially noticeable in tributaries with intermittent baseflows, where in dry years aquifer storage is used, to be replenished in wet years. Nonetheless, the Ahlfeld Report claims to identify supposed "large errors" in Beaver Creek in 2003 and to a lesser extent in the Frenchman Creek and elsewhere. Beaver Creek is a small intermittent tributary, a minor part of the total supply. The intermittent nature of Beaver Creek, as well as certain other sub-basins, makes it subject to non-linear responses more so than other areas. Storage effects and evapotranspiration effects represent a larger portion of the entire water budget in Beaver Creek than elsewhere, especially during dry periods. That fact was recognized and accepted during the development and negotiation of the Model, the Accounting Procedures, and the FSS. It is not a question of whether these non-linear effects exist but whether they should be attenuated or eliminated, as suggested by Nebraska.

## VI. Imported Water Supply Credit

One of the most significant effects of the Nebraska proposal is the increase in IWS credit that would result. This credit is only available to Nebraska. The IWS credit is the accretion to streams in the Republican River Basin in Nebraska, computed for each compact tributary and the main stem resulting from incidental recharge from Platte River diversions. The components of recharge include canal seepage, reservoir seepage and irrigation return flows from Platte River diversions. The Platte River facilities considered in the Model are shown on Figure 1. The diversions occur over a reach of 20 miles on the Platte River amounting to more than two million ac-ft/yr. The lands irrigated with this supply total 120,000 acres near the topographic divide between the Republican and Platte River Basins.

The total recharge to groundwater from Platte River supplies is estimated to be approximately 610,000 ac-ft/yr. The diversions and recharge amounts are shown of Figure 2. Actual Platte River recharge peaked during the 1970's and has been on a steady decline since then. Peak recharge amounts reached 680,000 ac-ft/yr during the decade of the 1970's, and declined to 600,000 in the decade of the 1990's. Since 2000, the Platte River recharge has declined to 475,000 ac-ft/yr, or to 70% of the peak rate during the decade of the 1970's. Reductions in recharge have been caused by reduced diversions from the Platte, system improvements and changes in irrigation efficiency over time.

Historical IWS credits are plotted on Figure 3. The average for the period of 1981 to 2000 was 16,300 ac-ft/yr, or approximately 2.7% of the total Platte River recharge input to the Model. Most of the Platte River recharge returns to the Platte River. Estimated accretions to the Republican River and tributaries increased from the early 1940's, to approximately 15,000 ac-ft/yr during the late 1980's.

The Groundwater Model is necessary to compute the IWS credit in Nebraska (Second Report, p. 64). As noted above, much of the Platte River recharge returns to the Platte River. Accretions reaching the Republican streams are highly dependent on water level conditions at the groundwater divide. Pumping along the Platte River affects the gradient of the aquifer and direction of groundwater flow. It is necessary to compute the Republican River accretions with the Model using a baseline condition that includes pumping so that the modeled water levels reflect actual conditions.

Nebraska's methodology would modify the IWS credit substantially. Figure 4 shows the changes for the years 2001 to 2006 proposed by Nebraska. The IWS Credit would be increased from 12,800 to 20,400 ac-ft/yr, a significant 60% increase. This increase is recommended by Nebraska even though Platte River recharge actually continued to decrease for this period and water levels were low due to higher pumping and reduced recharge in the Nebraska mound area.

The amount of accretion derived from the Model for the approved method and Nebraska's proposed method was compared to the amount of Platte River recharge documented above. Figure 5 plots the ratio for the period 1981 to 2006. The ratio for the currently approved method increased from 2% in 1981 to approximately 3% in the mid-1990's. This level was maintained until the recent drought years. The methodology proposed by Nebraska results in increasing ratios of accretions to recharge in recent years, exceeding 4% by 2006.

**VII. The Method Specified in the FSS and Accounting Procedures is not Flawed**

The Nebraska report (Ahlfeld report, p. 5 & 6) refers to "errors" in CBCU and IWS and refers to the accounting as comparing allocations to "actual water use". These descriptions mischaracterize the real situation. An "error" could describe one of two things; either the difference between a calculated value and a true or actual value; or a mistake such as adding two values that should have been subtracted.

The "error" that the Ahlfeld Report refers to is not an "error" in the sense of comparing an estimate to a measured or known value and it is not a mistake in the sense that the RRCA calculations are not what they were intended to be. It refers to a difference between calculations of CBCU and IWS using one method versus an alternative method and comparisons of those calculations to a third calculation. Nebraska assumes that this third calculation is the "true" value and then characterizes differences from this calculation as error.

The Ahlfeld Report's reference to "actual water use" is also a mischaracterization. The "actual water use" is not a known or measured quantity. Instead, it is a value developed through a calculation process as described in the compact and the FSS. These calculations represent methods of accounting that have been agreed to by the States for purposes of determining a value for water use that will be used to determine compliance with the compact. The calculations are based in part on various idealizations and assumptions that have been accepted for these purposes. Reference to these calculations as "actual" gives the misleading impression that they are more precise than they actually are.

Nebraska relies on the difference between the sum of the individual effects and the total impact of all stresses applied simultaneously (simultaneous impact) to conclude that changes are necessary to eliminate such differences. The necessity to eliminate such differences is not stated in the Compact, FSS or Accounting Procedures. Nebraska states that the lack of summation is caused by stream drying in recent years, an actual condition in the field as well as predicted by the Model. The Model is necessary to consider these conditions. The Modeling Committee did not state any limitation on the magnitude of the differences cited by Nebraska.

To check this conclusion, the differences between the sum of the individual effects required by the FSS and the simultaneous impacts were compared on a statewide basis for the entire period of 1940 to 2006. This allows the assertion by Nebraska to be checked against the results obtained over the entire model period considered by the Model Committee when the procedure was specified. Figure 6 shows the annual and five-year running average of this difference starting in 1971, as a percentage of the sum of the impacts. Prior to 2000, differences ranged from 3% to -4%. (The difference for 2003 is 3%.) Impacts are pumping depletions, with imported water supply netted out. As indicated by Figure 6, the differences have been positive for the years 2003 to 2006. Nebraska experts state a concern that any difference at all exists and the objective of their proposal is to eliminate the differences. As shown by the Model results, this was not a criteria for acceptance of the Model in 2003. Differences since 2002 are not substantially different than for prior years.

The Accounting Procedures set out a methodology to directly use the Groundwater Model to compute the GW CBCU for each state and the IWS credit to Nebraska. One requirement for the calculation of IWS credit is that actual water level conditions be considered. This requirement is met by using the approved and calibrated historical baseline condition. Nebraska's procedure introduces a series of baselines and effectively averages the results in a post-processing calculation not previously considered and apparently not unique. However, they fail to discuss the fact that these multiple "base conditions" are not equally reliable. The Model run representing the historical condition is different from all of the other model runs in that these

conditions were subjected to a calibration process whereby the Model results were compared to measured groundwater levels and stream base flows. These comparisons provided a direct measure of the Model's reliability that could be assessed and understood by each of the States. None of the proposed Nebraska "base conditions" can be evaluated in this manner and thus the degree to which these conditions accurately reflect a "true" condition is unknown. Yet, in the proposed scheme, the condition assuming no pumping or imported water is given the same weight as the historical condition that was subjected to the calibration process. Since the historical condition can be compared and evaluated against actual measurements, it made sense to use the historical conditions as the "base condition" as was done in the agreed upon RRCA method rather than other alternatives whose conditions could not be compared and evaluated against actual measurements.

IWS credits should be evaluated with Nebraska pumping on in order to insure that credits appropriately reflect water level conditions consistent with Nebraska pumping. Nebraska states ".. the impact of mound recharge is masked by the presence of Nebraska pumping" (Ahlfeld Report, p. 43) which is exactly the point here. Nebraska pumping reduces the mound credit.

**VIII. Conclusions**

Nebraska has requested that the method used to compute CBCU and IWS credit be changed to include additional model runs that deviate from the historical water level conditions. The change would have a significant effect on the results of the Groundwater Model used in the RRCA Accounting Procedures. Nebraska proposes a method that would increase Nebraska's IWS credit by 15% for the period prior to 2000, and by 50% for the drought period of 2002 to 2006.

Nebraska's proposal is based on a presumption that individual impacts must sum to a specific value and that this presumption was adopted or should now control how model results are processed for use in the accounting. However, this presumption was not stated in any of the decree documents describing the Model or accounting procedures. The necessity for impacts to sum to a specific value was not adopted by the States.

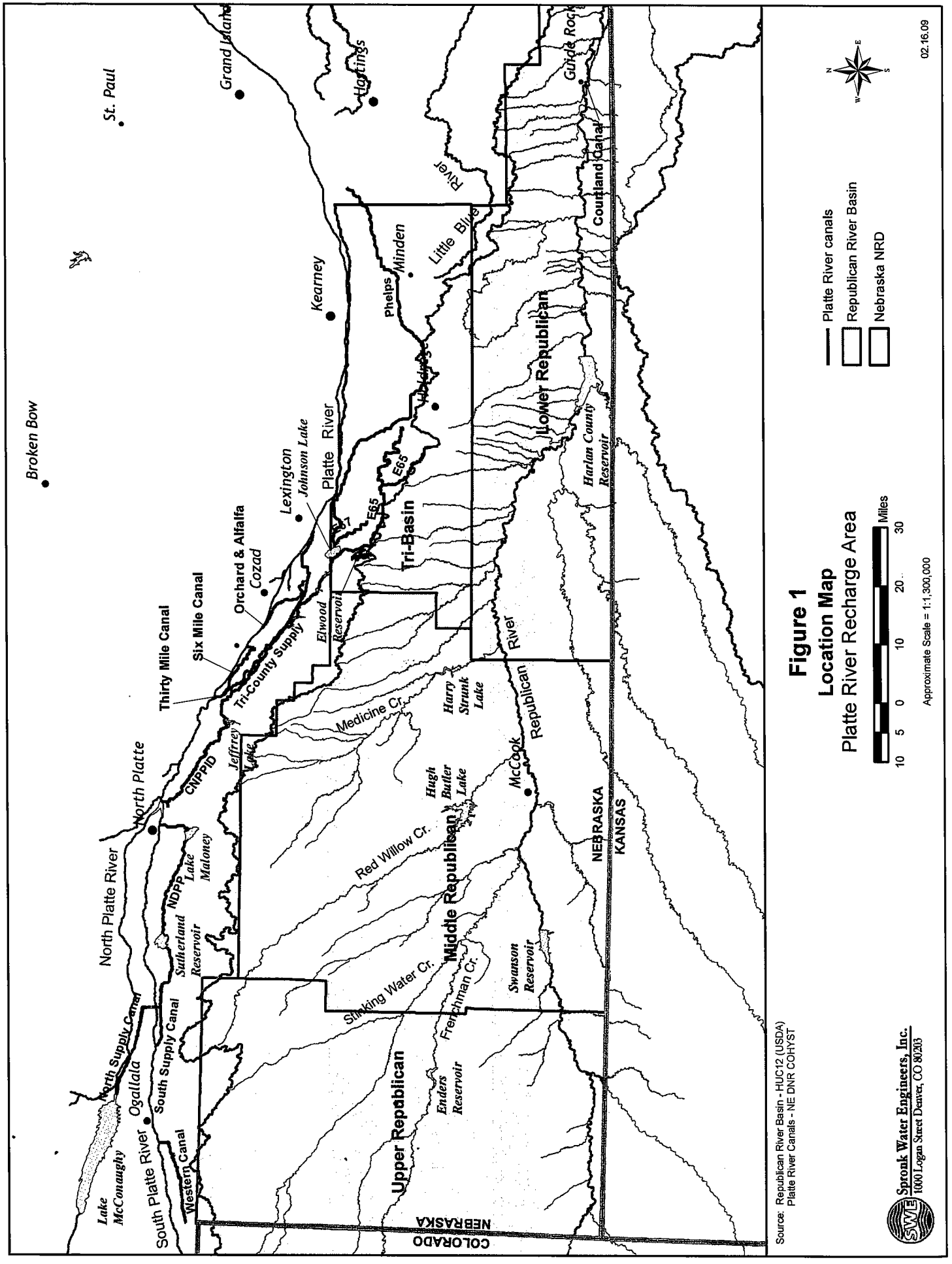
There is no "error" in the agreed upon method of accounting. The special master's reports and FSS clearly state that the Groundwater Model will be used to calculate the GW CBCU and IWS. This application of a model to determine impacts is common practice.

The Nebraska proposal requires a post-processing approach to translate model results to accounting elements, by weighting the results of new model runs. Thus, the IWS credit is no longer directly calculated by the Model with actual water level conditions.

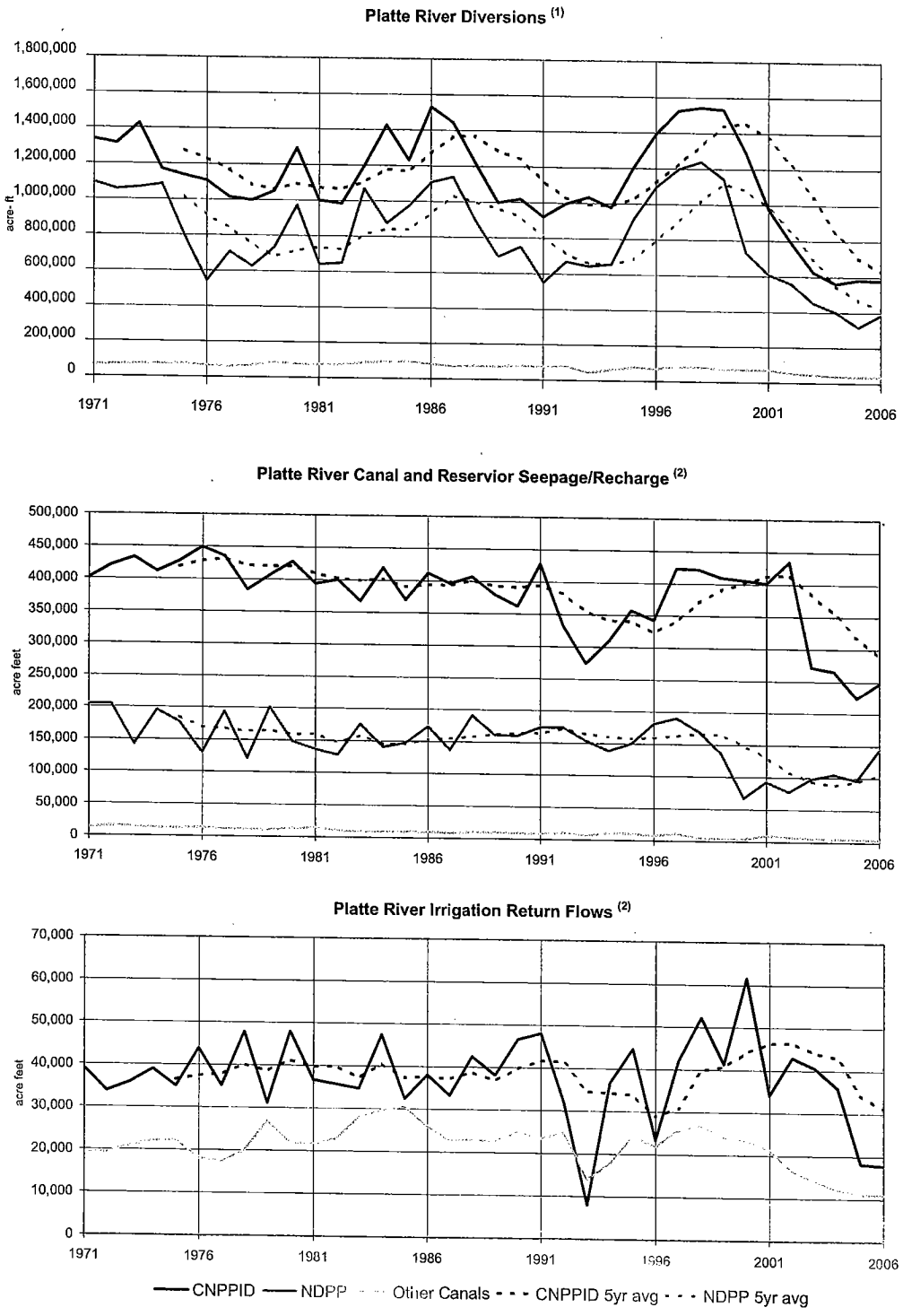
IWS credit is not a term in the compact, but was added during the development of the FSS because the Groundwater Model was going to be available to quantify it. Nebraska does not measure the water reaching the Republican streams, but rather must depend on calculations and modeling for determination of the small percentage of imported water that reaches the Republican River.

The current procedures were established by the Modeling Committee in their role of developing the Groundwater Model for the States and are reasonable and sufficient to estimate the impacts of the pumping and Platte River recharge. Nebraska concerns arose from conditions occurring subsequent to the end of the period considered by the Modeling Committee. However, a review of the model results since 2000 does not indicate any "errors" or need to implement accounting changes proposed by Nebraska, which would result in significant changes to the computed States' impacts.

# Figures


Broken Bow
St. Paul
Grand Island
Hastings
Gurde Rock
Courtland Canal
Kearney
Phelps
Minden
Little Blue River
Lexington
Johnson Lake
Platte River
Tri-Basin
Lower Republican
Harlan County Reservoir
Orchard & Alfalfa
Cozad
Six Mile Canal
Thirty Mile Canal
Tri-County Supply
Elwood Reservoir
Medicine Cr.
Harry Strunk Lake
Republican River
McCook
Hugh Butler Lake
CNPPID
Jeffrey Lake
North Platte
North Platte River
NDPP
Lake Maloney
Sutherland Reservoir
Red Willow Cr.
Middle Republican
Swanson Reservoir
Stinking Water Cr.
Frenchman Cr.
Enders Reservoir
Upper Republican
North Supply Canal
South Supply Canal
Ogallala
South Platte River
Western Canal
Lake McConaughy
NEBRASKA
KANSAS
COLORADO
E65
Platte River canals
Republican River Basin
Nebraska NRD
Miles
10 5 0 10 20 30
Approximate Scale = 1:1,300,000
02.16.09
Figure 1
Location Map
Platte River Recharge Area
Source: Republican River Basin - HUC12 (USDA)
Platte River Canals - NE DNR COHYST
Sponk Water Engineers, Inc.
1000 Logan Street Denver, CO 80203

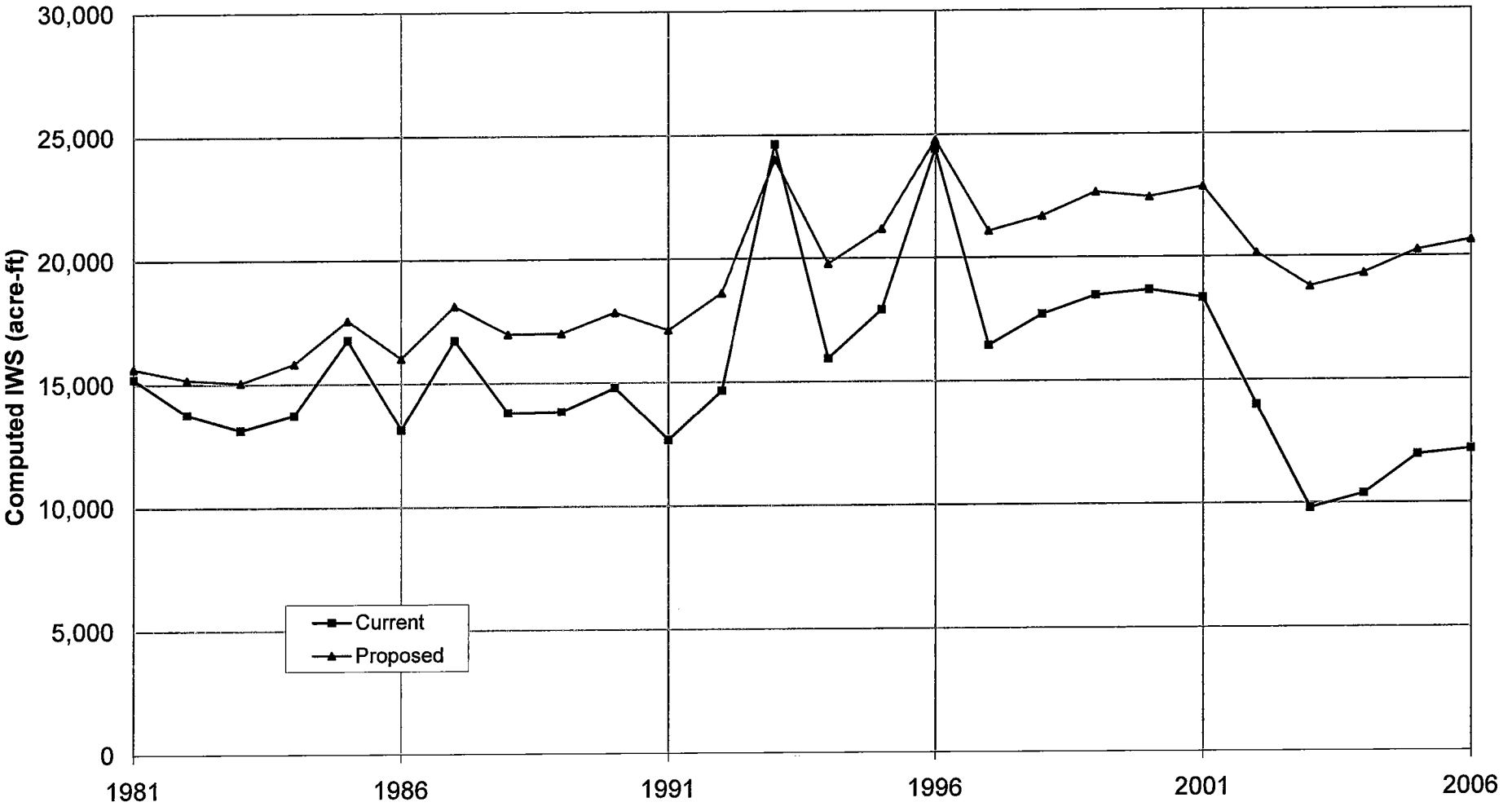
# Figure 2
Platte River Diversions and Calculated Mound Recharge
1971 - 2006
acre-ft




**Notes:**
(1) 2005 and 2006 Other Canals diversions estimated using relationship between CNPPID diversions from 1971 - 2004.
(2) 2001 - 2006 Other Canals recharge and irrigation return flows estimated using relationship between Other Canal diversions from 1971 - 2000.

**Figure 3**

Nebraska's Computed Imported Water Supply (IWS) Using the Current and Proposed Accounting Methodology
1981 - 2006
(acre-ft)

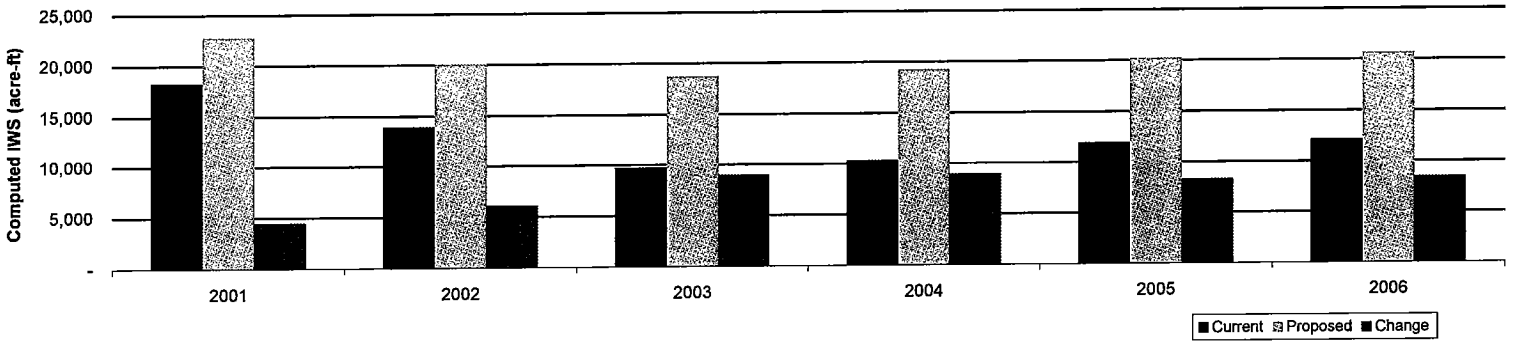



Note: Current IWS from areed upon RRCA accounting. Proposed IWS from Nebraska's proposed accounting (2001 - 2006) (Ahlfeld, et al., 2009) and generated by KDWR (1981 - 2000).

## Figure 4

Comparison of Nebraska's Computed Imported Water Supply (IWS) Using the Current and Proposed Accounting Methodology
2001 - 2006
acre-ft

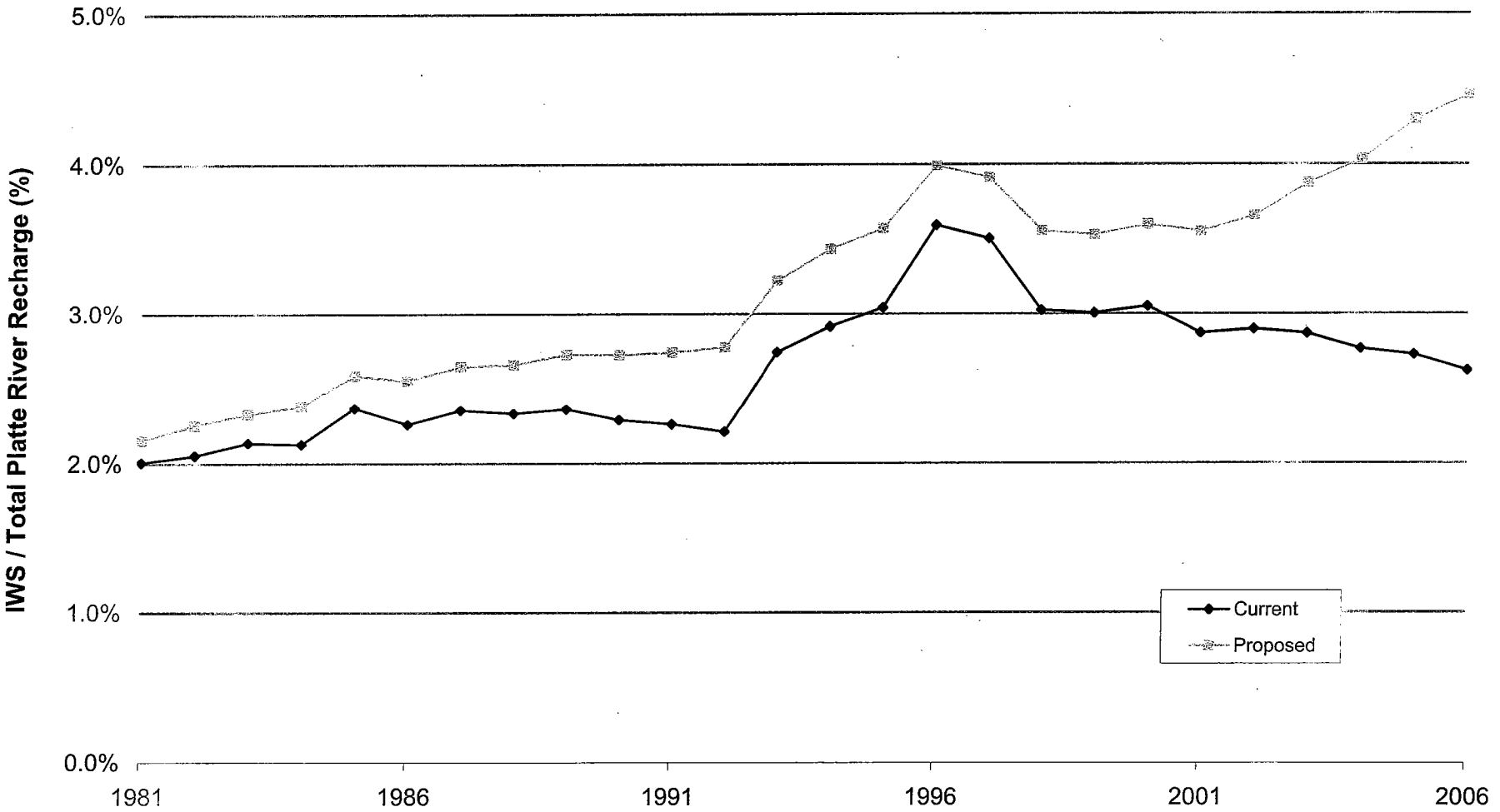
| | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-Basin | Current | Proposed | Current | Proposed | Current | Proposed | Current | Proposed | Current | Proposed | Current | Proposed |
| Maintstem | 9,009 | 13,266 | 5,608 | 11,162 | 334 | 9,044 | 826 | 9,453 | 2,288 | 10,258 | 2,752 | 10,794 |
| Medicine | 9,303 | 9,500 | 8,373 | 8,925 | 9,439 | 9,680 | 9,533 | 9,795 | 9,644 | 9,908 | 9,405 | 9,759 |
| Other | 29 | 71 | 24 | 64 | 20 | 65 | 25 | 70 | 34 | 82 | 25 | 102 |
| **Total** | 18,341 | 22,837 | 14,005 | 20,151 | 9,793 | 18,789 | 10,384 | 19,318 | 11,966 | 20,248 | 12,182 | 20,655 |




Note: Current IWS from areed upon RRCA accounting. Proposed IWS from Nebraska's proposed accounting (2001 - 2006) (Ahlfeld, et al., 2009) and generated by KDWR (1981 - 2000).

# Figure 5

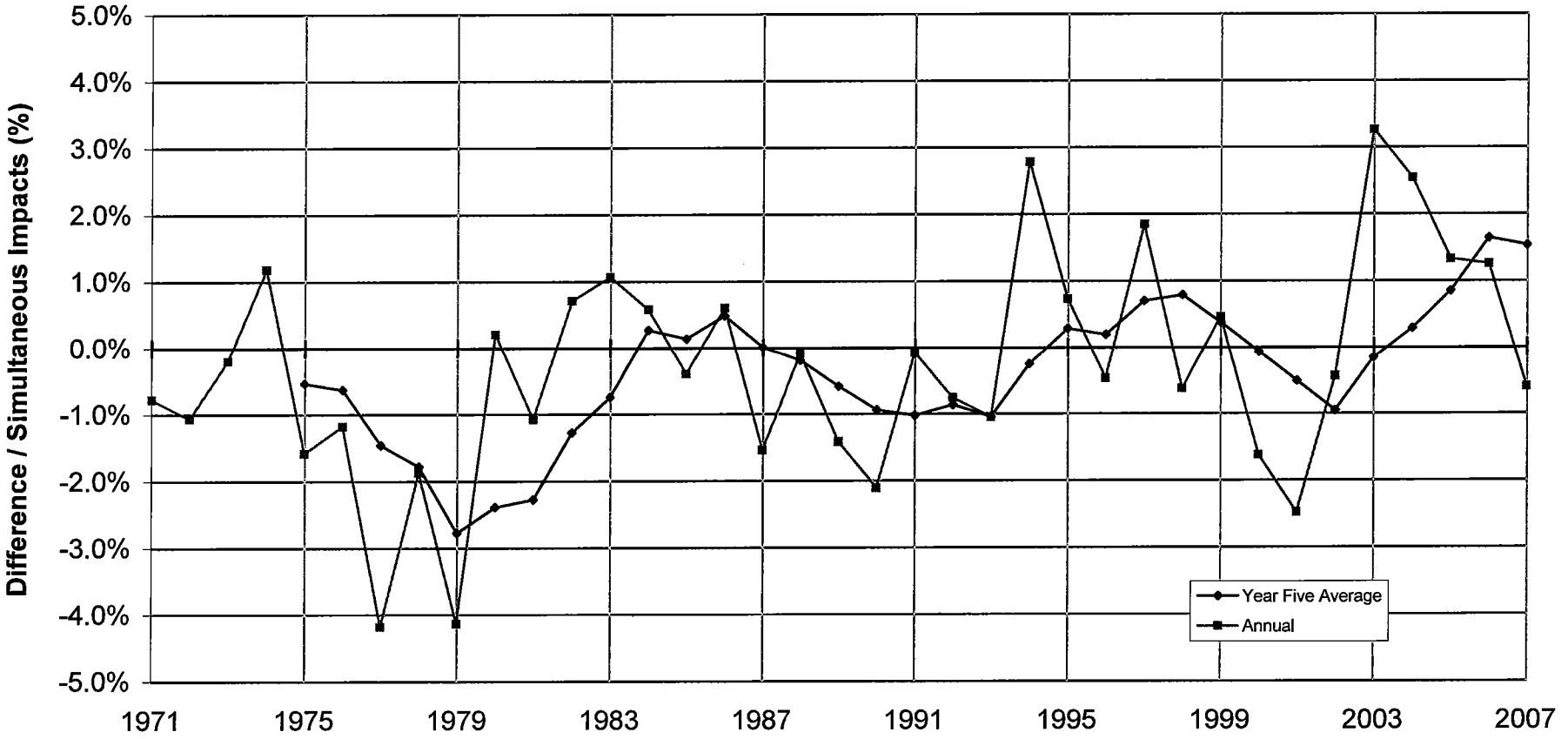
Imported Water Supply (IWS) as a Percent of Total Platte River Recharge
1981 - 2006
Five Year Running Average




Note: Current IWS from areed upon RRCA accounting. Proposed IWS from Nebraska's proposed accounting (2001 - 2006) (Ahlfeld, et al., 2009) and generated by KDWR (1981 - 2000).

# Figure 6

Difference Between the Sum of the Individual Impacts [1]
and the Simultaneous Impacts as a Percent of the Simultaneous Impacts
(Year Five Average and Annual % Difference)
1971 - 2007




**Notes:**

(1) Sum of the Individual Impacts = $CBCU_C + CBCU_K + CBCU_N$ - IWS